

## Swine Waste Electric Power and Heat Production Systems

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The Greenhouse Gas Technology Center, operated under a cooperative agreement between the U.S. Environmental Protection Agency's (U.S. EPA) Office of Research and Development and Southern Research Institute, has conducted performance verification testing on two combined heat and power (CHP) systems located at the Colorado Pork facility in Lamar, CO. Testing was conducted with the Colorado Governor's Office of Energy Management and Conservation. The two systems tested were

- a 30 kW Capstone microturbine combined with a Cain Industries heat recovery unit
- a 100 kW Martin Machinery/Caterpillar internal combustion engine (Model 3316) with an integrated finned tube heat exchanger.

Results indicated that the microturbine's net power output and electrical efficiency were negatively impacted by both the high altitude of the test facility and the parasitic load of the gas compressor. Nevertheless, at an estimated availability of 85%, the microturbine CHP could produce up to 150 MWh power and 875 MMBtu heat annually from biogas. At full load, emissions of NO<sub>x</sub>, CO, SO<sub>2</sub>, and THC averaged 0.08, 8.7, 37, and 2.7 lb/MWh, respectively. CO<sub>2</sub> emissions at full load were 3,450 lb/MWh, and particulate emissions averaged 0.62 lb/MWh. The IC engine CHP was limited to less than half of its rated capacity by biogas production rates. At this level of operation, the system could produce up to 136 MWh power and 765 MMBtu heat annually. At the highest load achieved, emissions of NO<sub>x</sub>, CO, SO<sub>2</sub>, and CH<sub>4</sub> averaged 12.1, 58, 23, and 112 lb/MWh, respectively. CO<sub>2</sub> emissions at this load were 1,970 lb/MWh, and particulate emissions averaged 0.09 lb/MWh.